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ABSTRACT

In order to make letter shape recognition an integral part of perception training, the use of the line in its two basic shapes is proposed. Letter shapes may seem exceedingly complex linear shapes to young minds. Thus instead of instruction in configuration, instruction involving transformational activities to manipulate and create the differentiating features of each letter should be given. This perceptual teaching approach may provide sub-skill foundations for learning to read that are important to developing cognitive processes. Learning sequences involving the use of blocks to shape letters provide multisensory, intrinsic, and constructive activities in addition to visual recognition. (MKM)

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Issues In Education

HILLEL A. SCHILLER

From Shape to Letters

ON INITIATING READING READINESS BY MEANS OF PERCEPTUAL TEACHING — A TECHNIQUE FOR PUTTING PIAGET'S "OPERATIONAL STRUCTURALISM" TO WORK IN EDUCATION

The New Role for the Teaching Aid

AS A PROFESSIONAL instructional materials developer, I take it as my job to relate theoretical ideas and experimental results to the creation of practical teaching tools of a certain nature. The teaching tool—that is, the visual, the audio, the tactile aid—has a new role to play in the modern instruction system. It is simply this: the teaching tool and any learning sequence must become *intrinsic* to the educational objectives selected. This means that they must become necessary to a specific act of learning rather than merely "enriching."

A teaching tool that is "necessary" to the educative act assists directly in engaging the interest of the learner by utilizing two fundamentals of learning that are part of all superior teaching. Dewey characterized these fundamentals as principles, writing that every act that was truly educative must exhibit *Continuity*, and *Interaction*.[1]

Today, in the course of normal teaching activities the creation of continuity and interaction is not obvious. The former necessitates the creation of a subtle process hidden within the student; the latter necessitates the use of particular tactics to gain and hold attention. Both these processes are often short-circuited and made victims of misplaced definitions or ignorance of methodology. The continuity Dewey means relates to the *interests* of the learner—it is the continuity of developing experience. It is not the continuity of a subject matter that a teacher seeks to create within the student, but the building of a continuity and fullness of *meaning* in an individual.

The developing of inner continuities can occur only if true *interaction* takes place between the learner and the teacher, or the teaching tool: be it a book, a material, a game, a question, or even a single word. It is the importance of generating real interaction—true communication—for the reformation of educational technique that we have undertaken to attempt to illuminate the nature and need for the development of more intrinsic learning materials.

Luchins[2] discussed criteria for audio-visual devices and attempted to define this quality of intrinsicness. He wrote, ". . . to the extent that the device is based on the structural features of the subject matter, it may be regarded as intrinsic; to the extent that it is unrelated to—or only peripherally related to—the subject of the lesson, it may be regarded as extrinsic." This then, briefly, is the most fundamental characteristic of an intrinsic material. But this was written before we began to question the nature of subject matter and the ways materials could be related more closely to making the learning process more efficient.

If the learner is to achieve a meaningful relation with (assimilate) specific features of a subject matter (content), it can only happen by means of an active process of interaction. Not only is learning never passive, as Piaget has shown us again and again, it is trans-forming or transformational.

The development of learning sequences is moving in this direction of becoming more intrinsic. It is encompassed in the trend seeking more relevance. This seeking for relevance attempts to link the subject matter with the learner, but it has not yet solved the problems of methodology or refined curricula. The ultimate significance of this new awareness has been commented upon by I. A. Richards:

> . . . Discern is the key word. . . . Consider the words "discern" and "concern." The etymology is from a sieve, or screen or strainer, which separates what matters for a situation from what doesn't matter. That is a fundamental of design. Clear the relevant. *Cut out the distracting*. It seems likely that, as more and more is done on *relevance* and distraction, design of instruction may become a dominant art of our age. It might even lure from advertisement some of the talent and resourcefulness so much needed in such work.[3]

Certainly some of the better episodes designed for *Sesame Street* have already fulfilled this prescient view.

But to get a sense of the extraordinary change that has

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taken place, let us look at the problem education faces from the far broader view of social analysis. The observations of Peter Drucker suggest that he has noted implications of what he calls the "information revolution" that must ultimately effect teaching methodology profoundly:

> We need a new concept of information and a new understanding of learning and teaching. . . . But while the information revolution will have its most dramatic impact on education, teaching and learning may not use computers at all or may use them only marginally. The materials, while certainly quite different from what we have been using—as different as the printed book of 500 years ago was from the oral tradition of the earlier schools—probably does not have to be big machines with huge memories. The amount of information needed throughout all the years of formal schooling is actually quite limited and hardly requires anything as complex as an electric memory. "Programs" can be a great deal simpler than anything the computer uses. An ordinary desk calender is, after all also a program, and a highly effective one. . . .[4]

These statements, which seem heretical as we recall the arguments put forth touting the "effectiveness" of Computer Assisted Instruction, support a school of thought that has been battling hard against an engineered "managing" of teaching, rather than a more humanized "guiding" of learning.

Drucker states the major problem education faces: "We have to raise the productivity of education if we want to staff it. . . . We have to make the teacher more productive, have to multiply his or her impact, have to increase greatly the harvest from his or her skill, knowledge, devotion and effort. . . . The productivity of education is too low even for the richest country."

Heretofore, it has been assumed that the dual problem of volume and quality could be solved only by what has been called a "technology" of education. The expenditure of funds in this direction has resulted in some capacity to handle volume, but it has failed astoundingly in its effect on quality, when the deepest sense of what is needed in education is considered.

In spite of long efforts to construct a technology of education, our understanding of technology's ultimate usefulness and direction is still incredibly naive. This is not to imply that it cannot help to solve education's problems, but that it will be able to do so efficiently only when we are able to recognize and admit the central problems.

One of the reasons technology has failed thus far is because of our still antiquated conceptions of what knowledge is, and because of an over-defined sense of what we think the cognitive aspects of thinking are. This accounts for the traditional emphasis on facts and a dependance upon the idea that information comes in "bits." Postman and Weingartner, in their deliberately outrageous, but often insightful book, *Teaching as Subversive Activity*, offer a broader perspective on the nature of knowledge in a modern, more effective curriculum. Even McLuhan's observation relating the content of new media to education is pertinent. Experience shows that new media forms first utilize antidated programing as their content. To correct this in education, it is not only new media's capacities that must be explored; new, deeper and synthesizing goals must be defined and refined.

True Multi-sensory or Perceptual Teaching

One last observation of Drucker's relates directly to the teaching methodology that is our major theme:

> All information, all the affirmation, and all the motivation should lie in the process of learning itself. . . . Teaching, on the other hand, has to do with meaning and insight. It has to do with application of information, with reaching out, with understanding and enjoyment, and with the insight that cannot be learned. ***Teaching has a lot more to do with perception than it has to do apparently with intellect.*** And teaching is done by example. (Italics added.)[6]

This sense of the essence of teaching is precisely what many of the great teachers of the past deeply understood. Some of them created materials that were intrinsic to an active learning process. Comenius's original illustrated text, Froebel's kindergarten "gifts" for children, Montessori's cylinders, Caroline Pratt's blocks, for example, were not mere gadgetry. The Cuisenaire rods for mathematics, and the Lettersticks' methodology to be illuminated here, are practical applications, too, of the idea that the perceptual process is in the primal position in education; that upon its basic training the progress and synthesis of all "cognitive" learning rises and falls.

For Dewey, observation was one of the keystone activities in all learning, and the whole world of experience was his intrinsic material. Barbara Biber, in her attempt to suggest a way to integrate the intellectual and emotional domains of knowledge, posits training for "Sensitivity" as the first of four goals, which include Discovery, Mastery and Synthesis.[7]

What undergirds and unites all of these views at the most fundamental level of learning is that they all are perceptually oriented and emphasize the importance of our perceptual processes.

Observable trends that partake of what may be called the teaching methodology of the future are tagged with other names today such as the "Discovery" or the "Inquiry" method, and relate to non-verbal levels of learning. At the base of these modes of instruction can be identified the unifying and ultimately synthesizing process that can

give a new methodological focus to the process of educating. It is perception taken broadly as a differentiation process in the manner in which the Gibsons have been describing it. If we can organize principles of progressive perceptual illumination of the levels of reality, we can begin to eliminate the gross distortion in the belief in the permanence of knowledge that has been plaguing curriculum synthesis and development.

Philosophically, perceptual teaching is a constructive or transformational process that is a direct application to education of ideas of modern Structuralism. This philosophic position has been described all too briefly by Jean Piaget himself in his newest work.*[8]

That perceptual teaching is a "structuralist" methodology gives it great intellectual strength, because the logic of its approach to teaching calls for putting on an equal footing with the *concept* the basic "element" of our perceptual processes, the *percept*. Only when these two information-transforming carriers are integrated in fundamental teaching methods can the art of teaching be blended with a technology of instruction.

But before discussing the percept as an information carrier and characterizing the *line* as the Elementary Boundary Unit in visual perception, we can perhaps make "perceptual teaching" a little clearer by calling attention to one of the major trends at work in the refinement of teaching technique.

E. Paul Torrance is one of America's foremost scholars concerned with creativity in education. The purpose of his new book, *Creative Teaching and Learning*, is to arouse "awareness" in the teacher of a new potential power that may be mysterious but is not miraculous, an awareness of the possibilities for training oneself to understand and participate in a creative mode of teaching. Of course, this awareness is the same as perceptivity or perceptiveness. But Torrance is not a romantic about creativity in teaching. By means of substantial research, he has been able to outline techniques drawn from the experience of many creative teachers, almost none of which would be alien to any teacher willing to try to improve her classroom methods. He concludes:

> I believe that there are subtle changes going on in the objectives of education that will make possible the emergence of an increasing number of teachers who can create an environment in which children can learn in a creative way—and at the same time learn the "fundamentals." With our explosion of knowledge, we have recognized that it is impossible for children and young people to acquire in school all of the information and skill they will need. The answer seems to be to equip them with the motivations and skills that will keep them learning for the rest of their lives. We are learning that a psychology of adjustment is inadequate for our age. Today's children must learn to correspond constructively rather than just adaptively or adjustively to change and stress."[10]

Torrance's use of the word "constructively" seems to imply active participation by the learner in a specific direction. Learning has been given a *vector*. It is a way to respond that seems to require a more positive action. But even this is not enough.

"Constructively" is clearly a *structural* term. It connotes building, putting together, relating, forming, reforming and transforming, and clearly too, it suggests a skill to be cultivated. As an educational objective, it is more demanding for the teacher, yet clearly necessary for our youth and times. It is for the teacher to draw this formative power from the student, not merely to "tell" him.

How does creative teaching relate to perceptual teaching? Creative teaching rests on perceptual teaching which provides depth and foundation.

Educators like Torrance, Postman and others, who are trying to suggest ways to improve methodology, have been fighting what is essentially an outdated, over-wrought verbalism in pedagogy. Torrance points this out:

> In our desire to understand cause and effect relationships within the teaching-learning process, attempts have been made to quantify this interaction. Such information has been helpful to teachers in gaining insights into their verbal techniques with children, but thus far we do not have very helpful techniques for assessing the nonverbal and often very powerful ways that teachers have for facilitating learning. . . .[11]

Perceptual teaching as a mode with a new emphasis attempts to attack problems of teaching strongly at the non-verbal or structural level, offering a synthesizing and integrating teaching technique. It is able to do this because it takes as a fundamental premise a basic perceptual fact underlying all observation: It accepts *change* as the only absolute.

The Nature of Change as an Educational Objective

Margaret Mead has observed that we have failed to recognize the new character of change in modern society. However, I believe that we have not yet even recognized the most significant aspect of "ordinary" change in the universe. Change never occurs abstractly—it can be observed only as it takes place within or between persons, entities, systems or patterns. It is the universal in Nature. Yet, in spite of its pervasiveness, we give very little instruction in school about the principles of change: its

*It is necessary to read this synthesizing volume in order to get one of the clearest pictures of the Structuralist's position. Piaget describes succinctly what he calls "operational structuralism" in which he offers a definition of structure as a "system of transformations" for which key criterion ideas are wholeness, transformation and self-regulation.

kinds, its levels, its interactions, its relationships, its basics. In fact most of us fear change and seek permanence instead. We have not yet come to understand the significance of knowing about the *transformations of forms, systems and patterns*, though in this knowledge may lie salvation. It may be that in today's world, systematic instruction about the principles of change is probably the most useful knowledge we can give our children.

Oddly enough, this educational objective would not be a difficult goal to pursue. We know many of the principles of change or transformation. We just have not learned how to emphasize them, or how to order them in curriculum building. If, then, we are ever to have *The Learning Society* that Robert Hutchins predicts, made up of individuals who can contend with rapidity of change, we need help. We are fortunate at a crucial level, though. Nature is on our side. It takes the human individual so long to mature that he should have time to learn how to adapt to the rapidities of change . . . if only his education would prepare him.

The Responsibility of Educators

The responsibility for instruction about change falls right into the laps of teachers and educational psychologists. And if we read their futures correctly they have mutually supportive roles in a single supreme task: ". . . to disembed subtle relational unities within the flux of experience," as Sigmund Koch has put it.[12] This is a new and unusual responsibility for education, but one with *depth*. For certainly most schools of today still teach little that is subtle, much that is only superficially relational, and almost nothing that is unified.

Jerry Getman has written,"Now quite apparent is the fact that we adults are unthinkingly creating learning disabilities in children. We much too frequently deprive them of the organismic and developmental prerequisites needed to permit them to validate new information by checking it with personal experience, and the introspection so essential to its integration."[13]

David Ausubel wrote some time ago, "It is part of our folklore that children are inherently incapable of precise thinking and observation. Because of this belief we are unduly lax and indulgent in our demands on children that they observe and execute acts carefully. We encourage an attitude of approximation throughout the period of childhood, and then suddenly at adolescence demand rigorous adherence to precise standards of work and statement."[14]

Ineffective teaching has opened enormous gaps in society. The gaps have become so large that they overlap, creating great vacuums. There is little true continuity, not only in life, but also in our educative processes, whether at home or in school. So in spite of lip-service given to teaching with the inquiry or the discovery method, the child and the youth get no solid instructional base for learning how to learn—or even from which to draw consistent and proper questions.

John Aldridge has an interesting insight: "The failure of the young to ask qualitative questions or at least to be concerned about them with anything like the intensity they display toward political issues seems to be the result of their lack of vital relationships with their physical and cultural surroundings. They cannot, after all, be expected to have a very clear sense of the quality of their environment if they have never seen it except as an abstraction or as a neutral medium of mass action, and do not bring to it aesthetic expectations by which they could gauge its aesthetic inadequacy."[15]

This gigantic gap resulted not so much from sins of commission as as from sins of omission, for as Edward Hall has pointed out[16] cultures leave much of the truth of life unsaid and vary greatly in what they leave untaught. Clearly we have been missing much among our lists of educational objectives.

But there are those who are looking for new elements in the pattern of missing objectives at this stage of crisis. Jerome Bruner, for example, has admitted there is much having cognitive effect that springs from the affective base.

If a superior education begins with a grounding in the sense of the particular and might even leave off formally after having achieved in the student a heightened sense of the particular, a major gap appears to have developed in the nature and methods of perceptual training. If we have failed in this process, all of the work of Piaget proves that we have failed in training many of our children to *think*. We have perverted perceptual birthrights and prostituted native intelligence.

Here is an experimental fact concerning a gap in content. In an attempt to find out about the knowledge of art terms among an art-interested high school group and a college sample of elementary education majors, Elliott Eisner at Stanford discovered that 23% of this group thought that the word "contour" meant "the illusion of movement in a painting."[17]

I take this example of ignorance as the symbol of an extraordinary gap in American curriculum. It is not a terminological or vocabulary problem. It is a gap in the sensing of the particular—the forgetting of a basic perceptual fact that anyone who has gone through at least an elementary geography sequence ought never to forget. It is a gap in a cognitive continuity, a mis-connection of meaning that underlies a conceptualization.

This sort of ignorance springs from the way we teach about *space*. Hall writes, ". . . only the very perceptive adult realizes that there is anything really difficult for the child to learn about space." Piaget and others have made crystal clear how long it takes the human mind to discover, master and synthesize spatial concepts.

How then might we begin to teach more effectively about space? Is there a spatial *particular* at the base of all visual sensing and higher mental operations? Can there be a way of connecting it with change and transformation in education?

The Line as "EBU"—The Elementary Boundary Unit

Near space is not empty. It is full of the things of life brought into direct meaningful contact with us by means of our "senses considered as perceptual systems." But in the formal instruction of our young, we have not yet developed a consistent way of introducing the differentiation of their perceptions. We usually begin by pointing out certain properties of things in space like shape, size and color, and inflict rather crude comparison drills and exercises. We offer unsubtly designed visual discrimination "skill sheets" that are narrowly oriented sections of reading readiness programs. The major goal of these, of course, is to acquaint children with our symbol systems and to get them to read as quickly as possible. However, this is not true perceptual education.

Though reading experts point to the "units" and levels of language to master in this process, beginning with the letters of the alphabet, the sole major element psychology has been able to suggest for use as the basic "unit" for our visual perceptual process has been the *shape, form* or *configuration* of an object or image.

Yet another fundamental element of perception has long been identified; the artist has used it since caveman days. The problem is to formalize its use and relate it in an operational way: first to man's perceptual analysis of his environment, which James Gibson has done; and then to place its role properly within man's educational process, which is part of what I hope to do in this paper.

The most useful element of visual perception is the rather ubiquitous graphic *line* in its two basic shapes: straight and curved. The line is a fundamental percept. As an information carrier it is the perfect perceptual "element" in the Structuralist's sense. As the fundamental visual percept, it can be called an Elementary Boundary Unit (EBU) by analogy with Hoijer's EMU or Elementary Meaning Unit, which he feels for most purposes defines the concept.[18]

Euclid claimed the straight line was infinite, and enthroned it in formal geometry. James J. Gibson pointed out its relation to the edge in reality, and to its properties on a flat surface. Piaget enshrined the relationships of its properties by research on perceptual activities as they mold and are affected by intelligence. John Dewey indirectly related its manipulations to the conceptual level (which we will discuss in the next section), and lastly Robert Gagné placed the mastery of the properties of the straight line at a particular level in the development of our logical process.[19] Our objective is to place it in the perspective of the perceptual teaching method as a major instructional element for the construction of schematic knowledge—to place it in the center of Piaget's assimilation/accommodation process. We will demonstrate a transformational way of instructing about the linear letterforms of our alphabet—teaching about them not as static configurations to be learned by rote, but as transformable shapes that can be made one from the other by the manipulation of their line elements.

We owe the illumination of the basic properties of the graphic line to a classic observation of James Gibson. In 1937 he made the simple observation that the visual line or border has two variable qualities besides length, as shown below:

Fig. 1. The Qualities of a Simple Line, from J. Gibson, Perception of the Visual World *(Houghton Mifflin, 1950) p. 195.*

He described them as follows:

> . . . One is left slant . . . zero slant . . . right slant and the other is convex . . . straight . . . concave. A line looks as if it had those phenomenal properties and behaves in perception as if it had them. The two dimensions of a variation are as much sensory as are the hue and brightness of color. They could be termed the quality of direction (linear slope) and curvature (linear shape). Mathematically, these two variables determine a curve at all its points. Phenomenally, the two corresponding qualities determine a visual line or border in all its (conveniently choosen) segments. If one specifies the direction and curvature of a short visual line has one not specified the entire experience?[20]

Here, then, is identified for us the basic interior imagal and exterior projective *perceptual element*, the visible line. By paying attention to its attributes and the types of relationships it can enter into as forms are constructed with it, we can up-grade it from being merely a perceptual "element" to becoming a systematic "unit" in the language of vision. Thus, it can be characterized as the EBU—the Elementary Boundary Unit, the building block of visual perception. Now its relationships to the Gestalt level and individual gestalts can be explored in a more informed manner.

The first significant effect this suggestion can have for the educative process is to open up another level of possible systematic perceptual training beneath that of the gestalt. The laws of gestalt no longer can be taken as

encompassing the only elementary laws of visual form. Indeed, as Piaget and others have pointed out, the major fault with gestalt has been its inability to explain the *generation* of forms.[21]

Bertalanffy, too, suggests something of the need for an operational level below that of the gestalt. He writes:

> . . . if we know the *totality* of parts united in the system, and the relations existing between them, then the behavior of the "Gestalt" can be interpreted by that of the parts, and lastly in terms of the ultimate physical parts and elementary laws.[22]

Now we in education can move away from reductionist and static concepts of perception in the direction of process thinking and synthesizing. And this is absolutely necessary because of the clear need of our total educative process—to educate the whole person.

At this new level of need in perceptual training the idea of *invariance* receives a new power related to the process nature of reality, not to static concepts of configuration. At this level the unit we have found is not the stable invariant *shape*, which has been the "ideal" and "perfect fact" of perception, whose labels we imprint in the minds of our children. In a process universe, the invariant is change! In Piaget's definition of structure, one third of its reality for him is transformation, transformation characterized as whole and self-regulating.

The invariant becomes a process concept by becoming operational in a form of activity in which perceptually the dimension of a line and the direction of a line must be concretely ascertained (creating invariance), when wishing to specify or create a unit in a particular visual system. In dealing with these attributes rather than shape as invariance, we must deal with fundamental spatial relations basic to all sensory-motor operations. We are dealing not so much with pre-fabricated units, so to speak, but with the processes that create visual shape for us—the eye movements that sequentially encompass the two ends of a linear dimension, that follow the direction of a curved line, that are drawn to the point of intersection of two lines.

Thus, the invariance we try to establish initially is not of a total structure, but more importantly of a relationship of units that make up the structure's system. If it were not for these relationships of units one to the other, we would not even be able to perceive a structured system. For that which is a system—a self-regulating whole—depends for its existence upon the invariance of its elements. These elements, of course, in perception and reality are manipulable and transformable by operations, which by altering their properties create new relationships among them and thus new forms within a larger system.

Therefore, lines as concrete elements to be drawn or compared can be established as the EBU, the fundamental manipulable, transformable structural unit in perception and graphic arts expression. Systematization among the combinatory possibilities and relationships of juxtaposed lines are perceptual geometries.

The transformations accomplished by this juxtaposing of EBU's are always syntheses. In the operational world of learning, it is structural transformation that is most significant to understand; but what is not yet highly illuminated about these processes of transformation is that a structural transformation is a synthesis, just as Piaget's own description of "operational structuralism" itself is.

In our human perceptual, thought, and expressive processes, which exist only and entirely on structural bases, we must recognize more broadly in the teaching profession that their very modes of existence are *operational*. They represent the capacities for organized and organizable *change*. Their systematic continuities are made manageable by means of the transformations of elements in forms, patterns, systems and schema. The search for constancy, invariance, or "permanence" then becomes the search for the *continuities among relationships* between simple elements in structures, or systems of structure, which themselves range through different levels from the simple to the complex.

Gibson again provides us with a simple example by means of which to show the process nature of an invariant. In Piaget's terms, this "complete" set of rectangles (Figure 2) is a whole transformable, self-regulating graphic shape system.

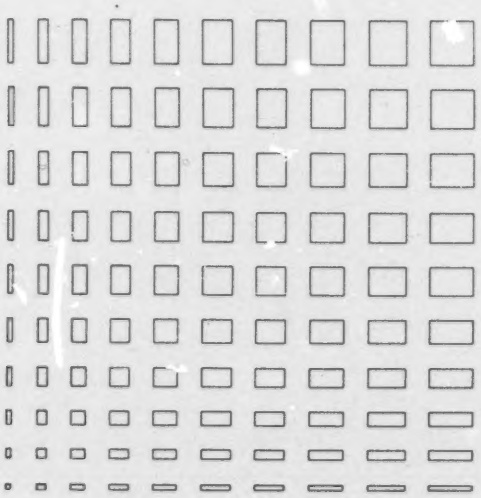

Fig. 2. The Transformations of Rectangular Shapes, J. Gibson, op. cit., p. 194.

If we start to compare the individual shapes to find an invariant that can account for the characteristic form of these shapes, we discover an interesting fact: a *transform dimension* accounts for or unites the significant perceivable differences (*SPD*) in this systematic series of shapes. The

first invariance we find is the position-of-most-stability within this shape system. Here four equal lines form all the squares. The positions of the squares in the rows and columns are dictated by the relationships created by the invariant equality of line lengths.

Moving away from this position-of-most-stability (symmetry) in any direction within this system of rectangles we find the next invariance to be an invariance-in-process created by an instability—a gradient of unequal line lengths that is systematic. This can be characterized as the transform dimension and must be stated as an operational rule. This rule governs the construction of all other rectangles surrounding the position of most stability in this shape system. The transform dimension (TD) is simply: Change the length of a pair of lines.

Here we can see the true synthesizing power of the structural or transformational approach that uses a perceptual dynamics based on the properties of visual elements.

Gibson's projection of rectangles is an example of a perfectly regulated shape system. In it the transform dimension, the changing length of a pair of lines, is the concept guiding the construction of any shape by interrelating the properties of two shapes by means of a transformational "from-to" conception. This is an example of a conceptual synthesis of subject matter developed by perceptual means.

The ultimate efficiency promised the teaching profession by the structuralist approach is revealed by the fact that this is true *relationship* teaching. It is crucial to note, too, that visual comparison and selectivity by means of which percepts and concepts are interrelated to produce meaning for the individual is accomplished by the scanning operation of visual searching or observing, itself the basic physiological "image" constructing mechanism of visual perception.

The Significant Relationships of Percepts and Concepts

It was John Dewey who gave us the clue that makes the line a major matter of content and a universal conceptual teaching tool in early learning. For he told us how to connect the *percept* of the line in space with its *concept*. And he did this in 1891!

Dewey asked, "How can the concept of a triangle advance our knowledge of the percept of a triangle?" And he answered, "The concept 'triangle' . . . is the *way in which three lines are put together;* it is a mode or form of construction. Except as we know this mode of formation our idea of a triangle is exceedingly imperfect." This construction is a mental activity that creates the principle of triangularity: "It cannot be felt, seen or heard, it can be grasped only in and through the activity which constitutes it. The only way to know the concept triangle is to make it—go through the act of putting together the lines the way called for."[23]

This Dewey explained long before Piaget and his workers showed us the basic fault in Gestalt psychologies: their neglect to explain how compositions or configurations are built up.

Piaget has shown that "every figure is subject to a phase of structuring, due to perceptual activities." Further, he sums up the relations between perceptual activities and the conceptualizing operations of intelligence in this way: "In the end, the relative adequacy of any perception to any object depends on a constructive process and not on immediate contact. During this constructive process the subject tries to make use of whatever information he has, incomplete, deformed or false as it may be, and build it into a system which corresponds as nearly as possible to the properties of the object."

And so Piaget's investigations have established for education the primacy of *transformational* learning over *configurational* learning. Both he and Dewey revealed the process nature of the concept.

The Concept as Means Rather than End

The concept is a dynamic teaching tool, a process of interaction dealing with multiple discriminations of relations and qualities. Unlike the percept's attachment to the concrete and "outer" space, the concept has to do with "interior" space — symbolic space.

The building of this inner symbolic and representational space—an interior map of reality—takes an extraordinary amount of time. For example, in learning to draw, it takes a youngster two to three years to move from being able to copy the line figure of a square to being able to copy the rhombus (diamond) accurately. So there is plenty of time for things to go wrong. Even the establishment of the inner awareness of up and down and left and right is not simple. George Early points out, "In the entire universe no object is left or right, up or down, before or after, *in and of itself.* These terms denote relationships, require a point of reference to have meaning."[24]

This is why Piaget has emphasized that his methodology is a *relational* one. He says, "Only the use of purely relational language and concepts for the analysis of perceptual phenomena can explain the developmental connection between perceptual processes and the growth of intelligence. . . . no appeal must be made to entities, faculties, or factors beyond the *relations* themselves and their interconnections."[25]

That is why perceptual teaching approaches can introduce more effective relational teaching into early learning procedures from the very start.

"First words must have intense meaning for a child," wrote Sylvia Ashton Warner, "They must be part of his being. . . . Pleasant words won't do. Respectable words won't do. They must be words organically tied up, organically born from the dynamic life itself. . . ."[26] And we can add that these first words ought to be systematic in a rela-

tional way to build spatial coherence and to avoid perceivable contradictions. They ought to reinforce a continual coordination of interior space growing directly from a child's experiences.

The perceptual teaching approach may be a way to eliminate confusion in the first true test of cognitive power—learning to read. It may be a method to subvert remedial needs by means of an initial preventative kind of instruction —something American education is just coming to. It may be a mode of learning whose economy would be incalculable.

From Shape to Letters

We hypothesize that the way sub-skill foundations for learning to read are laid may be more important to the developing mind than the reading process itself. For it has been said that "Precision in the structure of inner space is one of the firmest foundations for adult rationality."[27] One of the most important sub-skills is learning the letter names. Chall reports that being able to identify the names of the letters in kindergarten or the beginning of first grade is an important predictor of reading achievement. "In fact," she says, "letter knowledge has a generally higher association with early reading success than mental ability as measured by various intelligence tests of language and verbal ability."[28]

By teaching the letter shapes differently we may also be able to initiate a process that will create and cultivate a flexibility-of-response perceptual set which may be able to affect an individual's ability to adapt to changing situations. By concentrating on the manipulation and construction of relationships as well as the manipulation of whole forms, we can innovate to maximize basic perceptual training. We can begin intrinsic instruction in learning how to learn. We will be doing things differently that clearly have to be done differently, yet we will know what we are doing and striving for.

"To know," writes Piaget, "is to construct or to reconstruct the object of knowledge in such a way as to capture the mechanism of that construction."[29]

Some reading experts feel that learning the names of the basic geometric shapes is useful in preparing the young mind to learn the letters of the alphabet. However, the way it is done today is perceptually primitive and limited. It certainly cannot be called systematically effective. The letter shapes themselves exist within a system, yet at the same time they incorporate individually geometric "whole" shapes that are irregular, incomplete, hybrid, symmetrical, asymmetrical, larger and smaller than each other, etc. They are exceedingly *complex* linear shapes, particularly to many young minds. Yet to most adults, who hardly pay heed to them any longer except to undertake teaching them to children, they are considered simple *shapes*.

Because the perception of any complex form commences with the perception of some of its elements, a general objective in instructional materials design and in teaching can be to create the means to guide the sequence of the perception of these elements. This is why the establishment of fundamental units is so important.

In attempting to understand the structure of language, a modern systematization occured when linguists determined the structural character of *phonemic* systems. The phonic or aural level of language was organized and the significant *sound* features were identified. The existent written symbols came along for the ride, so to speak, because they were there, having had an orthographic evolution of their own as graphic writing systems. Now we can approach the systematization of *printed symbols* motivated by the needs of instruction.

Charles Fries, the linguist, recognized the importance of systematilizing the letter shapes.[30] He assembled them for instructional purposes according to their component parts (strokes, circles, etc.), an obvious and useful terminology based on how the letters are written. And Dr. Montessori pioneered the sandpaper letters. Fries' suggestions, nevertheless, remain essentially a linguistically based method that is static. Montessori's tactic, though appropriate, is a limited configurational exercise that is not true or original construction.

Eleanor Gibson took a more experimental approach and established a number of facts. She has shown that the "true units of the graphic code are not necessarily single letters."[31] She investigated the distinctive features of letters, and offered a clearly organized chart to show them. She inferred from her work that, ". . . while children probably do learn prototypes of letter shapes, the prototypes are not themselves the original basis for differentiation. The most relevant kind of training for discrimination is practice which provides experience with the characteristic differences that distinguish the set of items. Features which are actually distinctive for letters could be emphasized by presenting letters in contrast pairs."

I believe we can do a lot more than this. For we can carry instruction logically downward beneath the configurational level and use the lower-order EBU elements for constructional purposes. This path of disclosure would be a *relational* one actively participated in by the teacher and the student. It requires transformational activities to manipulate and create the invariant differentiating features of each letter.

So, rather than merely label shapes, or merely feel or trace them, we can instruct in a process of perceiving and physically relating the basic elements of shape: creating a process in which shape and the relationships of shape systems one to another are *discovered*.

This more intrinsic mode of early perceptual training can be designed around the perceptual orientation of the line and the identification and manipulation of its fundamental properties. It is my firm belief that this perceptual process approach can not only *ease* the normally developing child,

Features	A	E	F	H	I	L	T	K	M	N	V	W	X	Y	Z	B	C	D	G	J	O	P	R	Q	S	U
Straight																										
horizontal	+	+	+	+		+	+								+				+							
vertical		+	+	+	+	+	+	+	+	+				+		+		+				+	+			
diagonal /	+							+	+		+	+	+	+	+											
diagonal \	+							+	+	+	+	+	+	+									+	+		
Curve																										
closed																+		+			+	+	+	+		
open V																				+						+
open H																	+		+	+					+	
Intersection	+	+	+	+			+	+					+			+						+	+	+		
Redundancy																										
cyclic change		+							+			+				+									+	
symmetry	+	+		+	+		+	+	+		+	+	+	+		+	+	+			+					+
Discontinuity																										
vertical	+		+	+	+		+	+	+	+				+								+	+			
horizontal		+	+			+	+								+											

Fig. 3. From E. Gibson, Principles of Perceptual Learning and Development *(Copyright (c) by Meredith Corp., reprinted by permission of Appleton-Century-Crofts, Educational Division, Meredith Corp.), fig. 5.5, p. 88.*

but also be effective with the so-called dyslexic or others with potentials for maladaptations that would hinder their grasp and use of graphic language.

This approach provides the young mind from the outset with simple, concrete, *structurally* rather than *arbitrarily* systematic perceptual clues. These clues are percepts that relate the spatial properties of *direction* and *dimension* operationally and conceptually. Thus it can reinforce the building and coordinating of the inner space—and offer the eager young eye and mind a schematic way of dealing with the level *below* that of the symbolic gestalt out of which the letter forms, and all other shapes, spring.

For example, the following graphic sequence is a process or transformational way—a perceptually more logical way—to teach the recognition and the construction of capital letter "A." It is a sequence of developing actions in which the basic elements of its characteristic shape are cumulatively related in terms of direction and dimension until its final form is built. This process can be demonstrated in any visual medium, but the *intrinsic medium* in which the most effective perceptual teaching and learning can be done is with the straight stick.

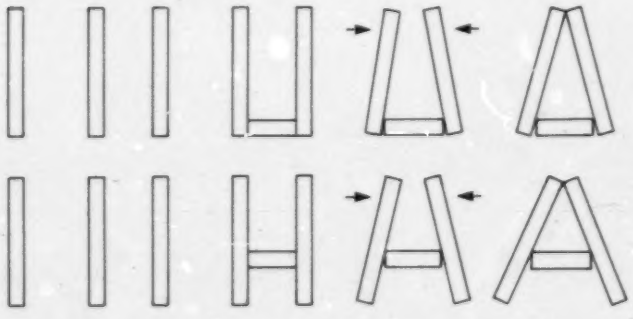

Fig. 4. Schiller Letter Shapes.

In proceeding this way we are demonstrating the nature of capital "A" as a shape—not as a symbol. What we have begun to do is to lay an aesthetic base for observing and explaining the difference (perceptual relationships) among the capital letters, though our educational objective was to teach the shape that is called "A." As we maneuvered the sticks toward the shape "A," we also passed through the shape stations for "U" and "H." This, some children will discover for themselves!

In differentiating the "H" from the "U," for example, the SPD, significant perceivable difference[12] is dimensional—the distance from the bottom of the verticals providing the fundamental perceptual/operational clue. In differentiating the "A" from the "H," the SPD is directional—the slant of the two major elements providing the distinctive characteristics of each letter.

The kind of perceptual analysis we have been using here is a kind of process geometry, or as Piaget calls it, "perceptual trigonometry." It emphasizes the two essential properties that create visual shape for us: length and direction, and their relationships in EBU's that combine to form simple or complex gestalts. By sequencing them in this developmental way, concrete physical properties are emphasized. Because this method synthesizes basic perceptual information, it should be able to provide tremendous economy in instruction.

This mode of instruction can begin very early with the

child. Perceptual sequences like these hold attention and can be coordinated in an interdisciplinary way with block-play, a sadly under-used learning technique in our public schools. Here is a mode of visual-tactile instruction that can be a perceptual educational core for reading readiness programs.

We should begin at the bottom if we wish things to work out right at the top. "The best education," said Alfred North Whitehead, "is to be found in gaining the utmost information from the simplest apparatus."[33]

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